Upper Ocean Dynamics in the Tropical and South Atlantic from High Density XBT Lines AX08 and AX18

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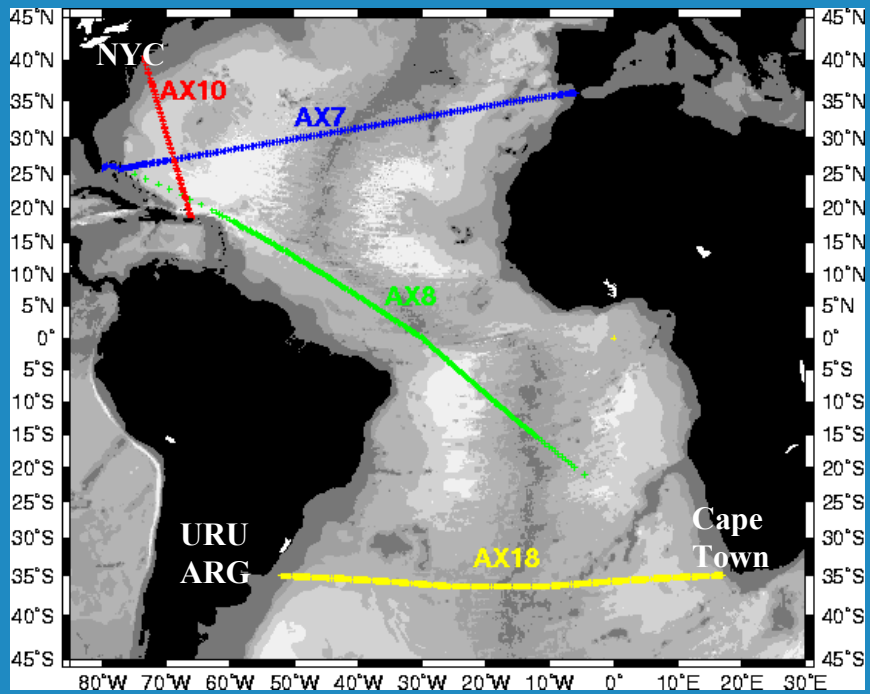
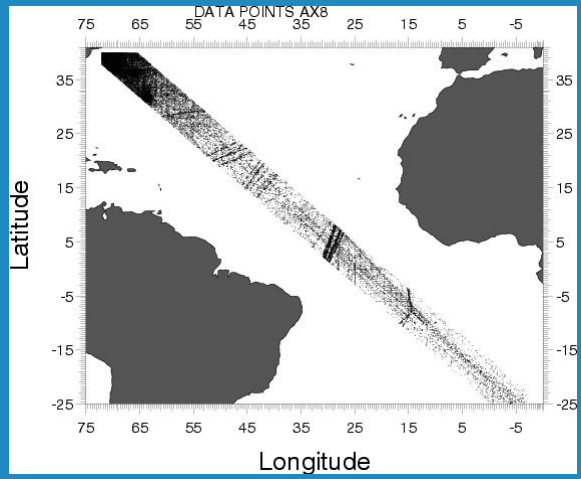
Motivation

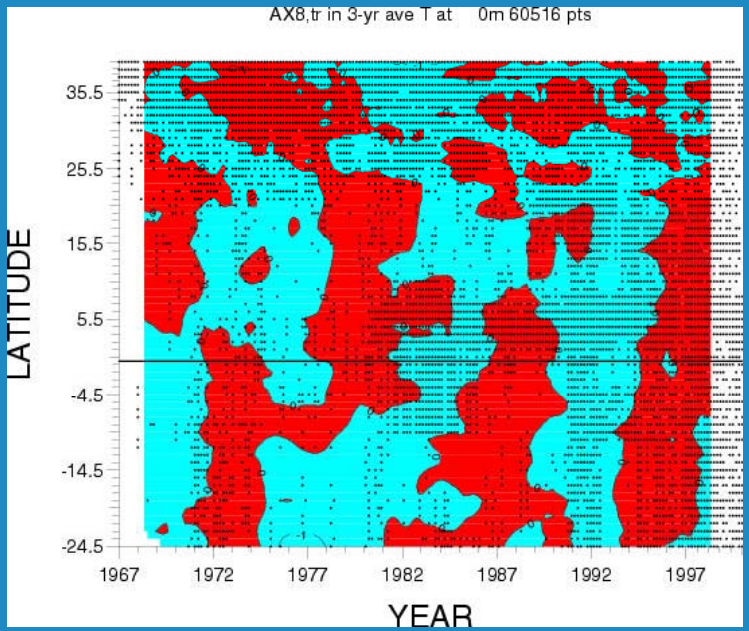
* 2(AX18) 4(AX08)
Times a year
* Every 40 km

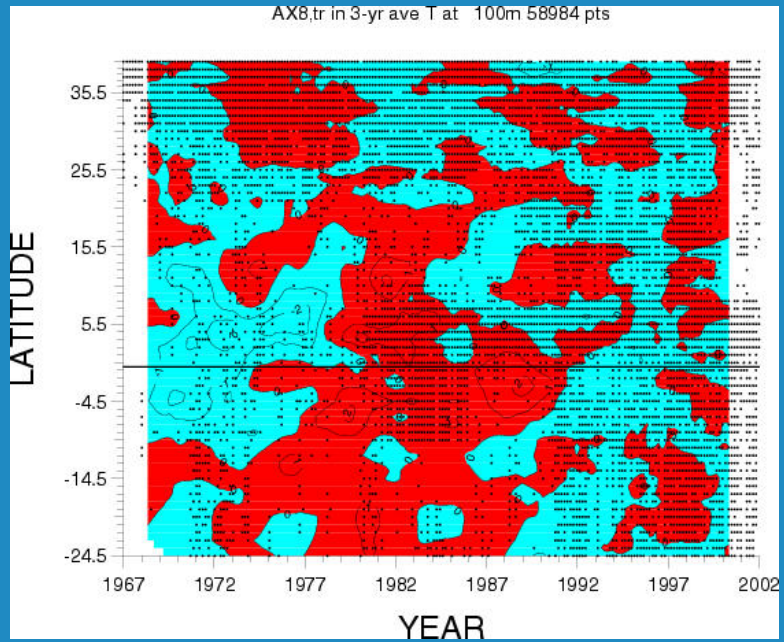


- Investigation of the variability of zonal currents in the tropical Atlantic to aid in the study of the role of upper ocean dynamics on sea surface temperature.
- Meridional water mass transfer across the equator.
- Investigation of the meridional heat transport across 30-35S.

Historical XBT data along AX08

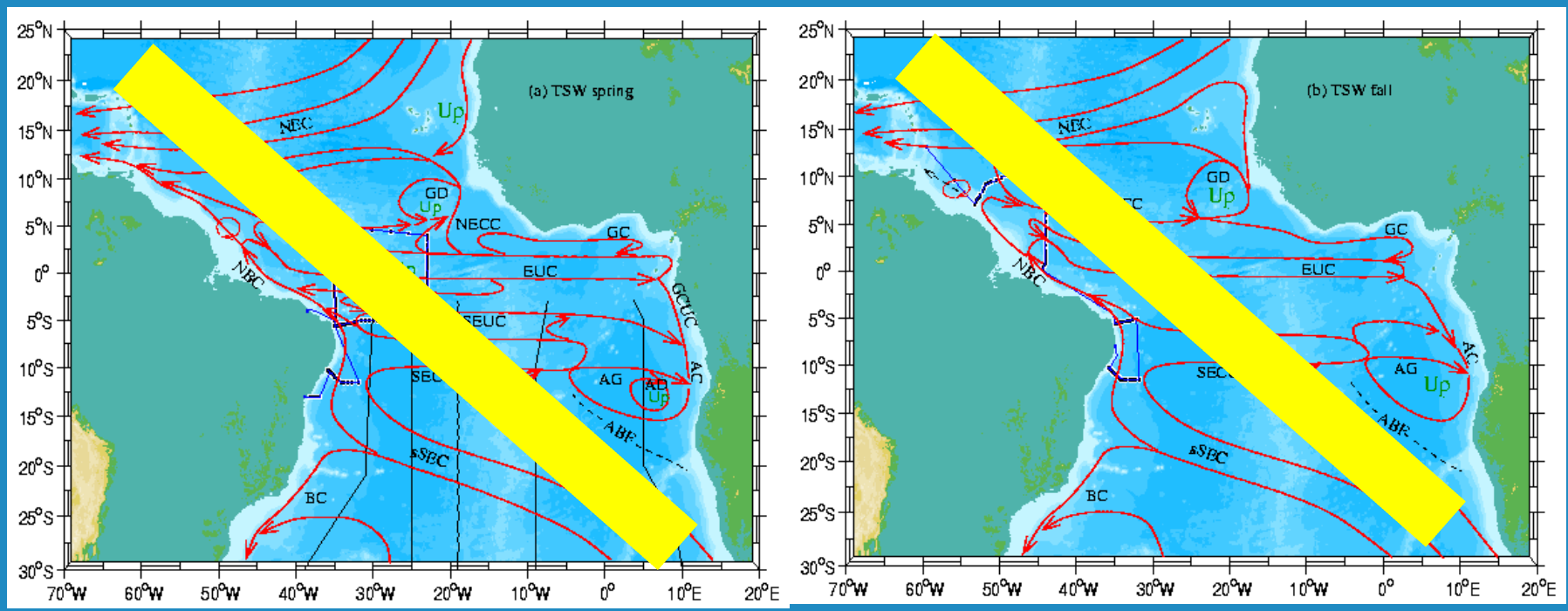






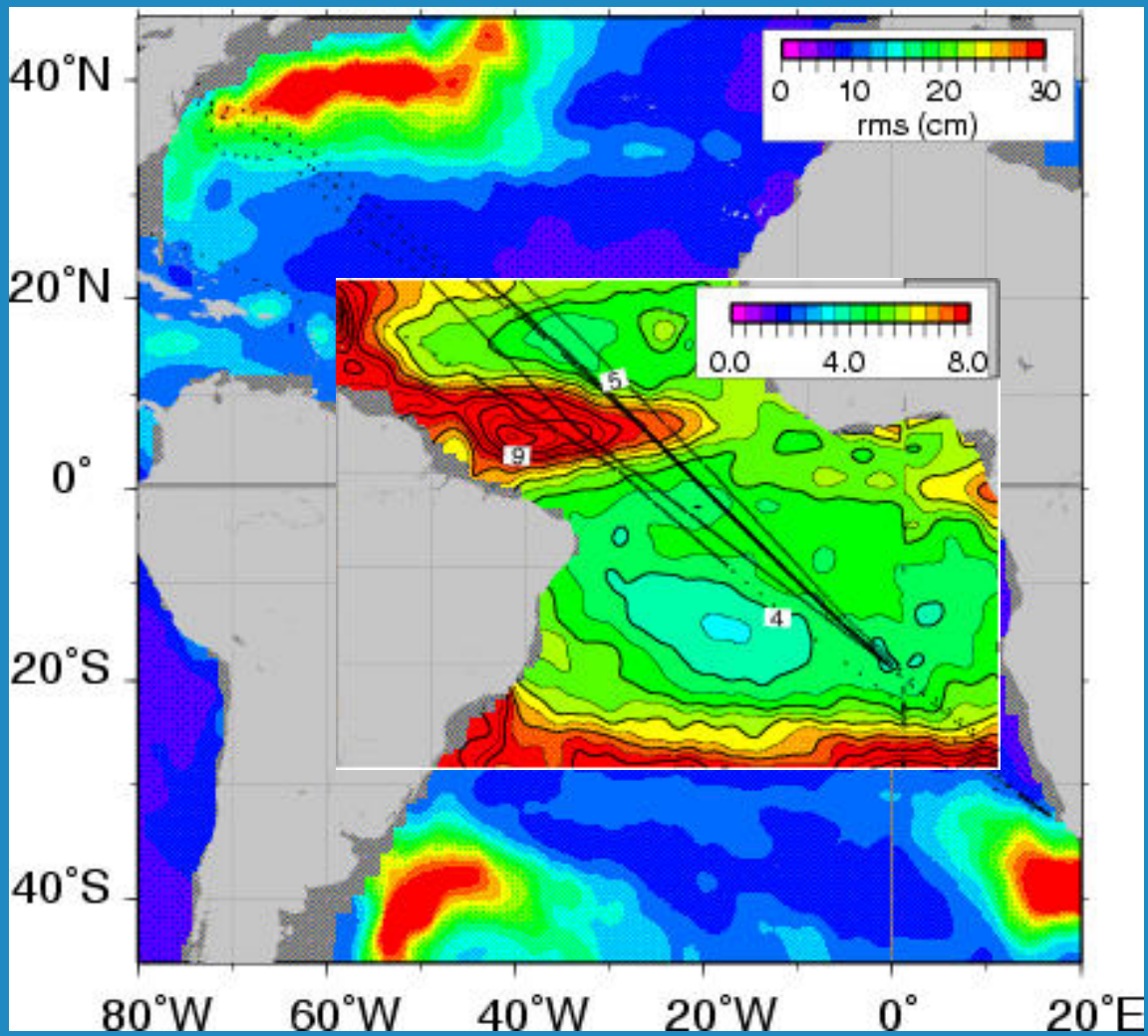
Figures by R. Molinari

AX08 and the major surface currents in the tropical Atlantic

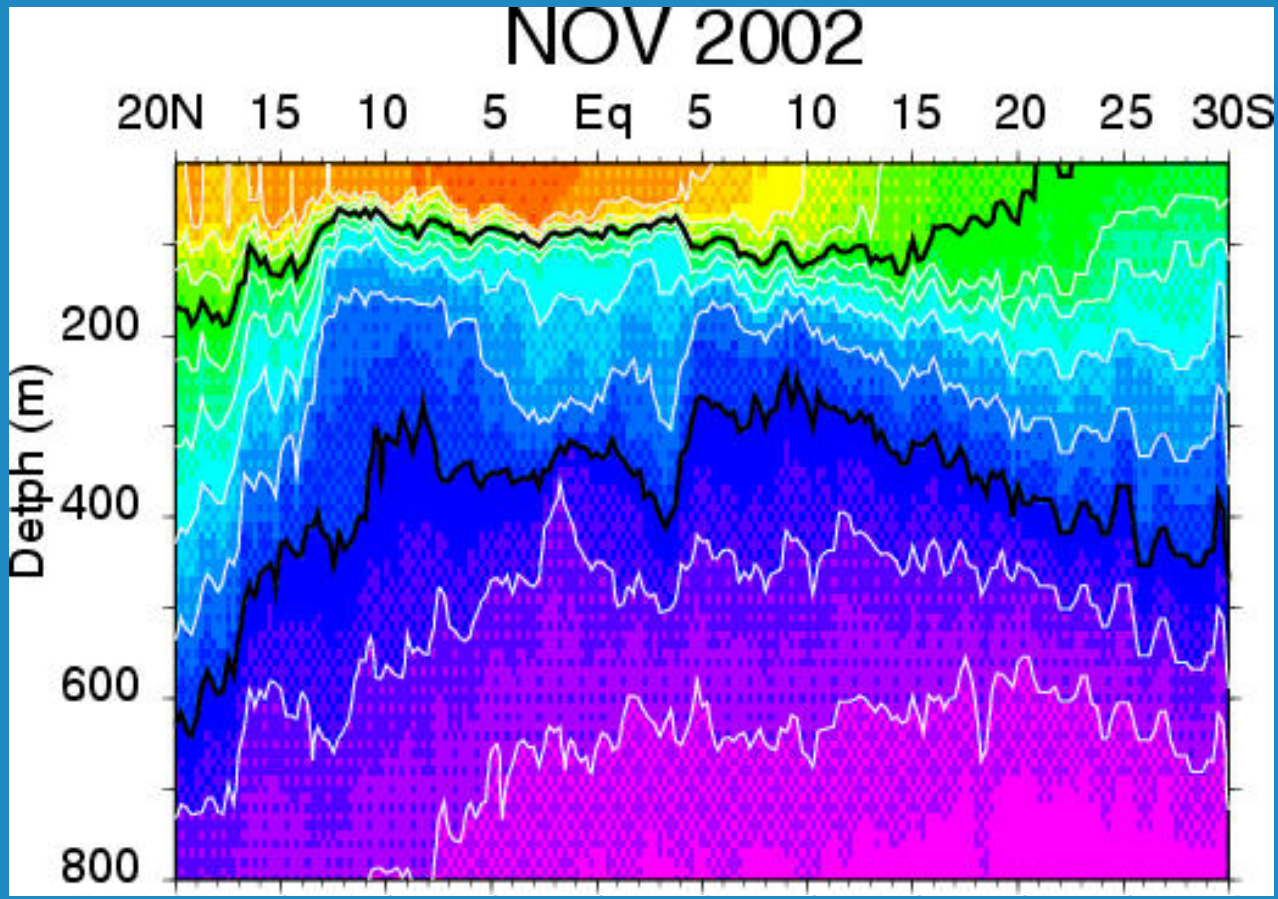


From Stramma, Fischer, Brandt and Schott, 2003

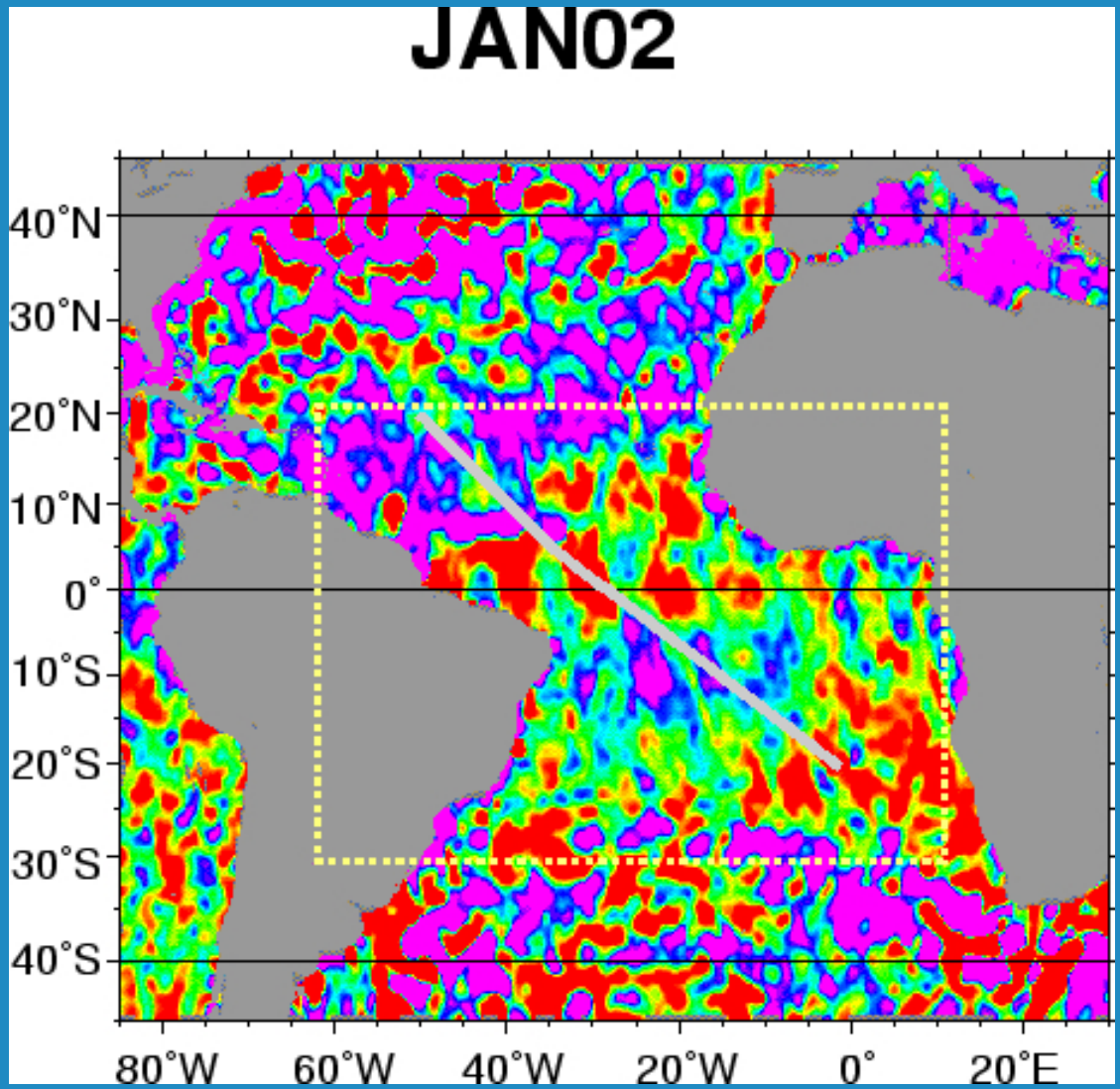
Sea height variability



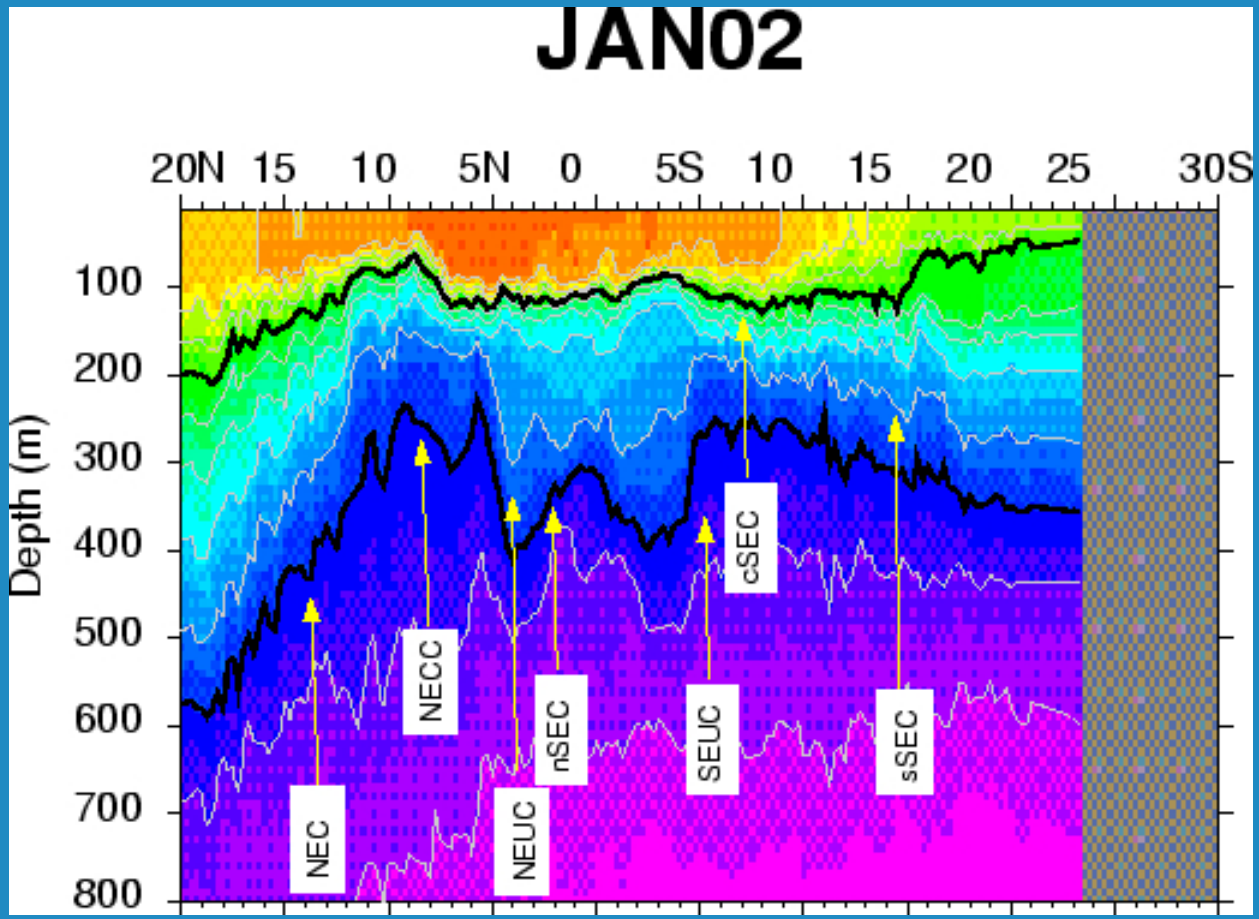
The first six transects in AX08



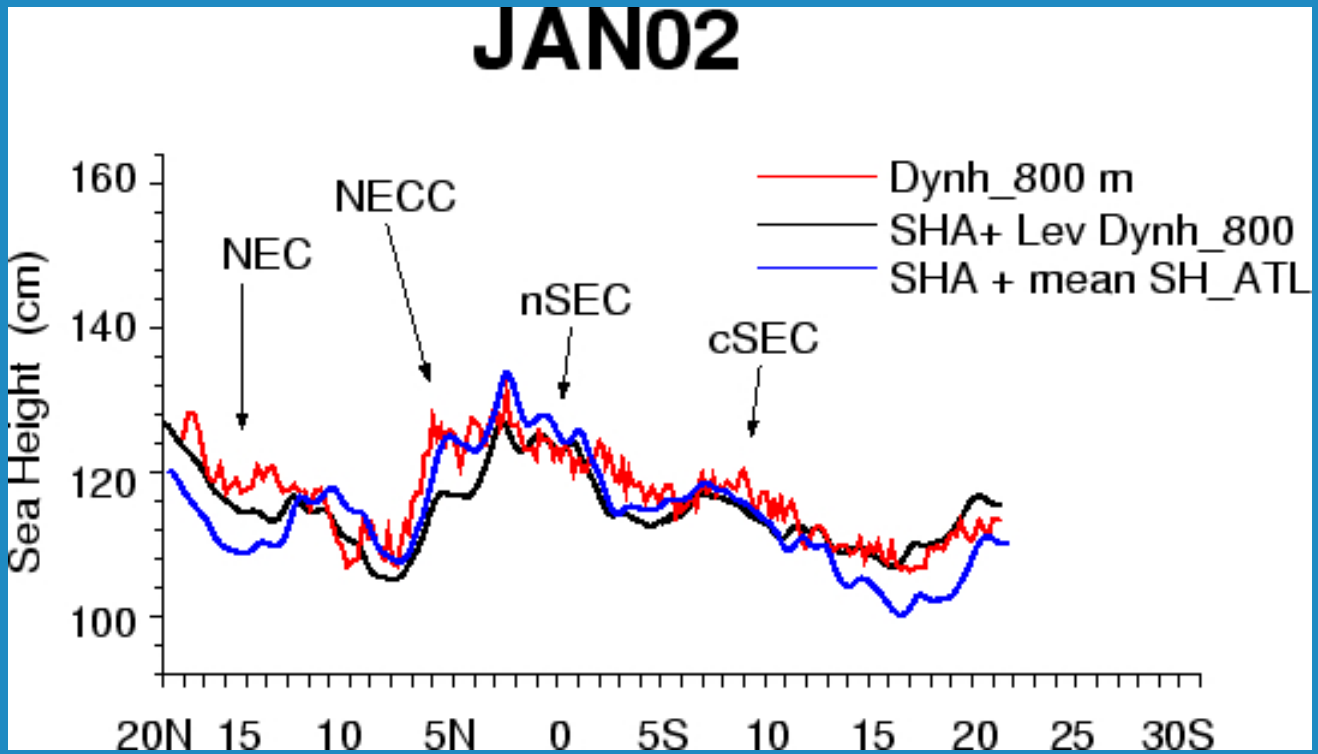
Sea height anomaly field



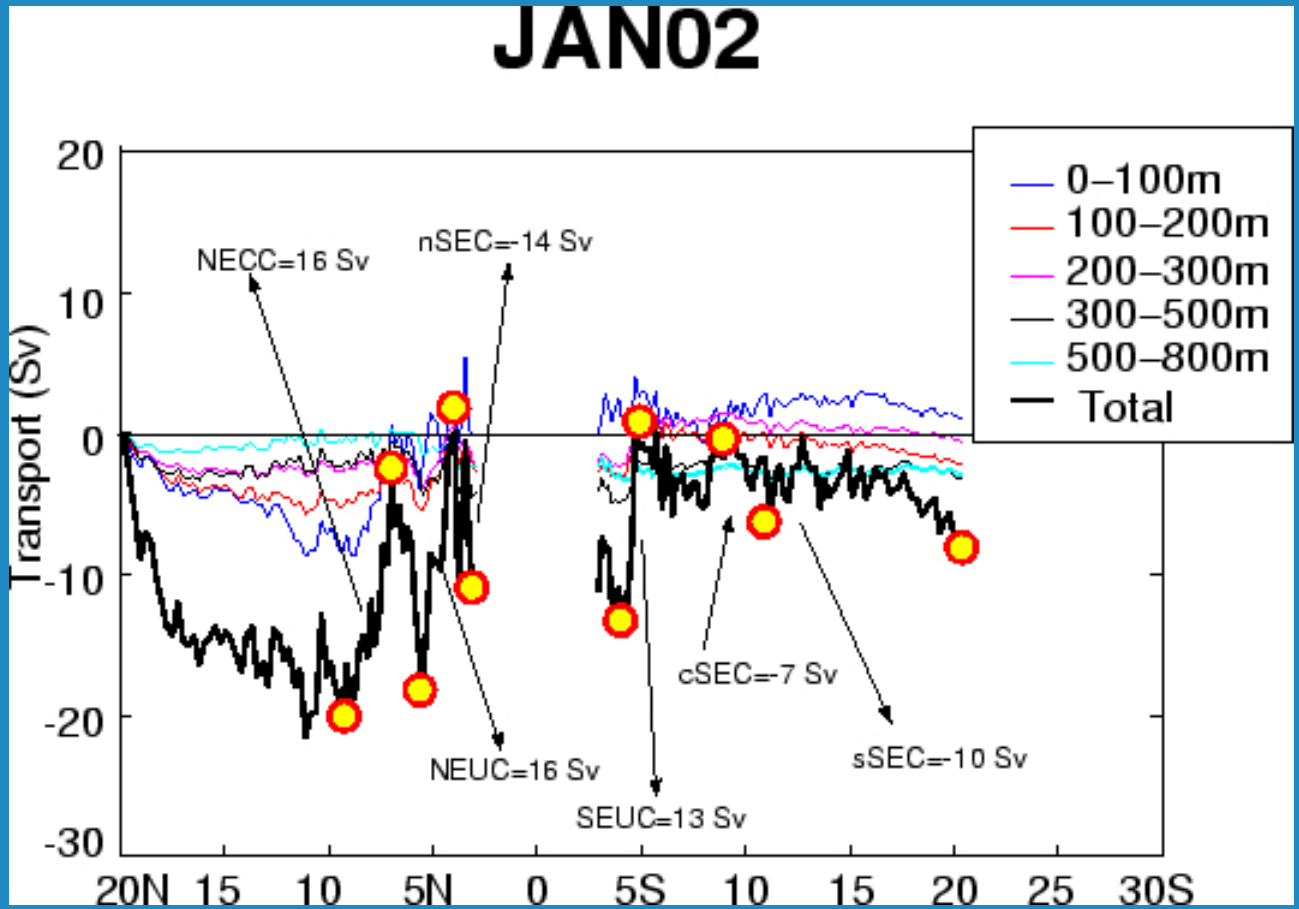
Temperature section

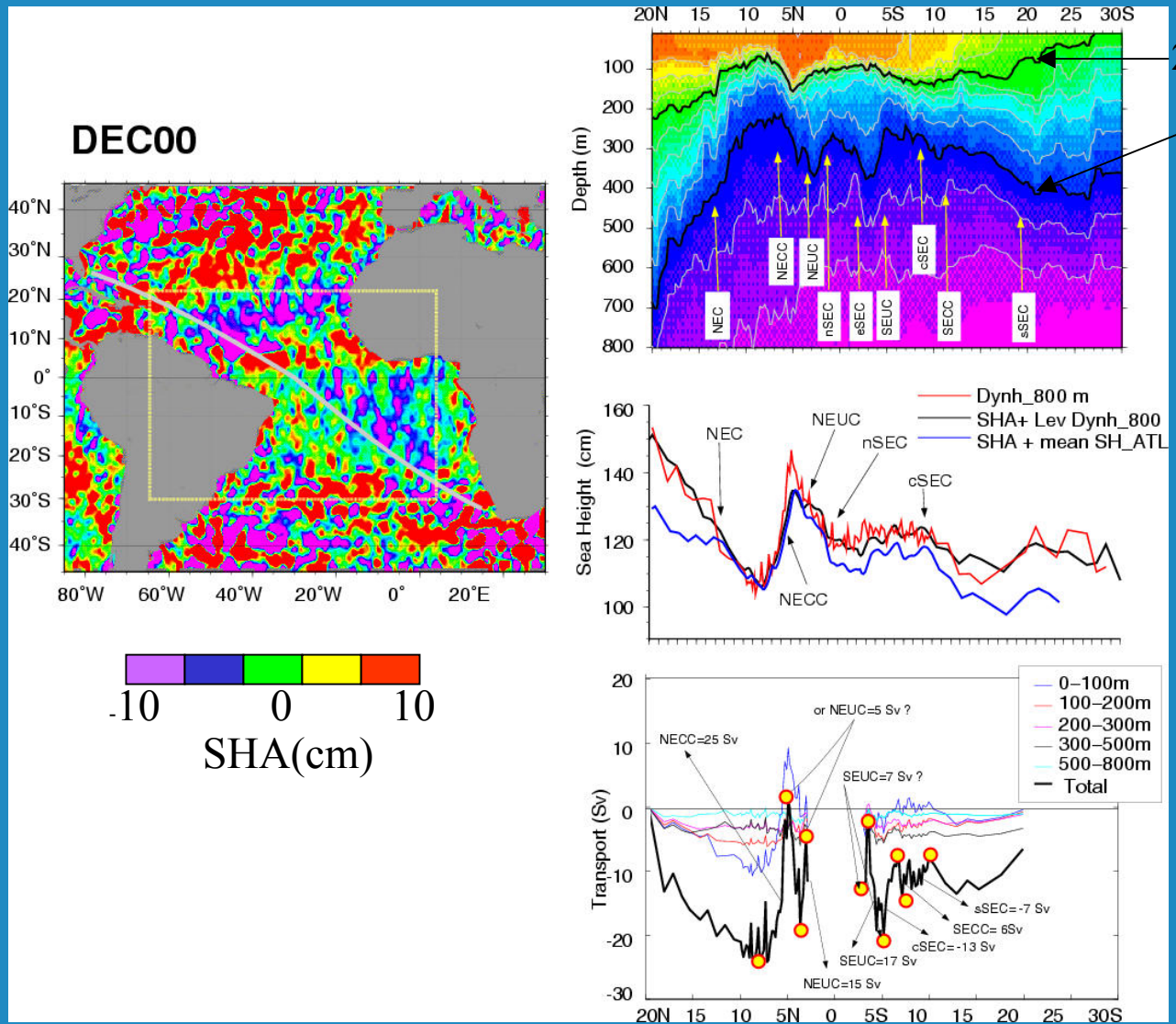


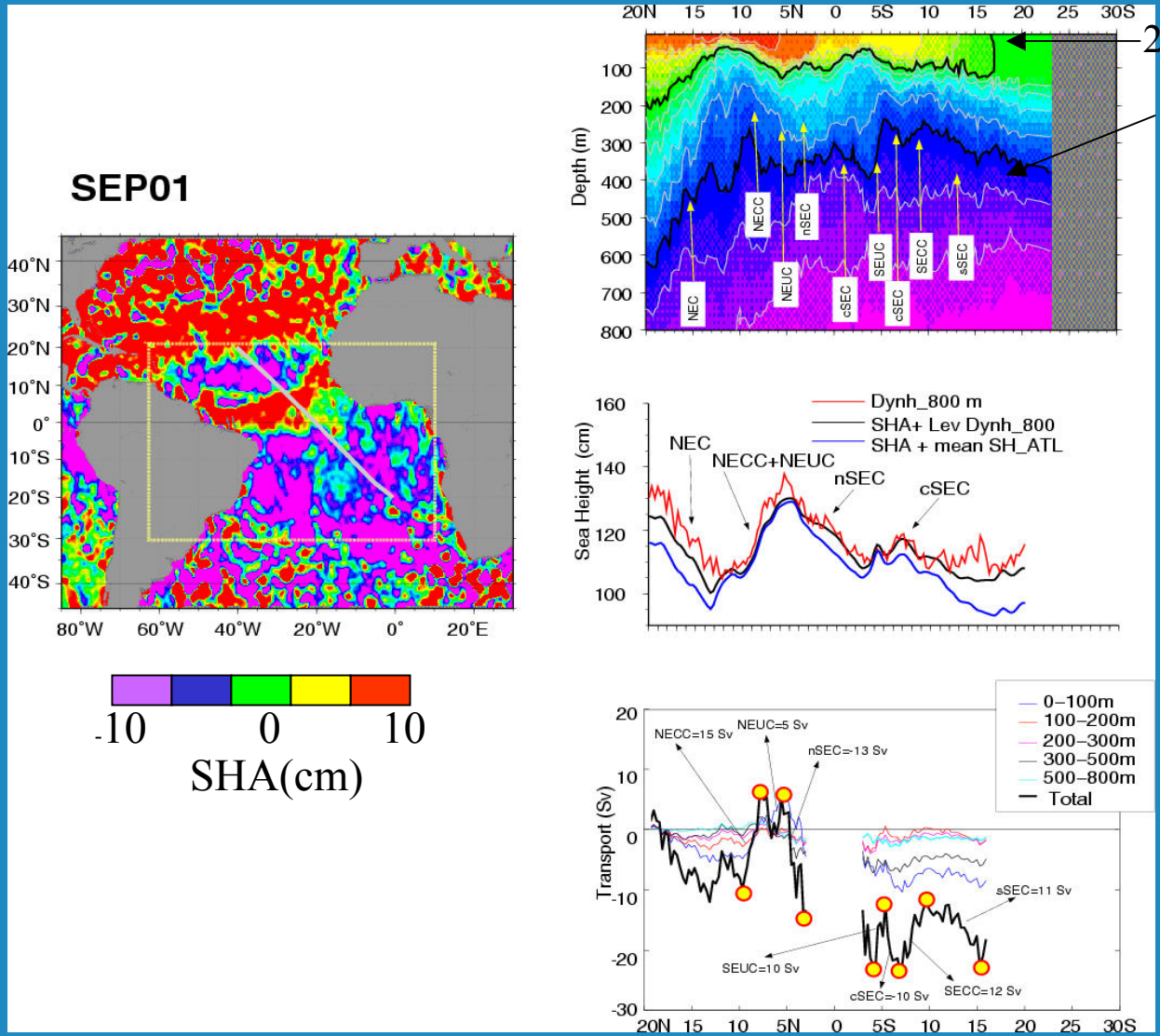
Dynamic height



Cumulative geostrophic transport




DEC00
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NECC
NEUC
nSEC
eSEC
SEUC
cSEC
SECC
sSEC
20C
10C
Sea Height (cm)
160
140
120
100
NEC
NEUC
nSEC
cSEC
NECC
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
Transport (Sv)
20
10
0
-10
-20
-30
NECC=25 Sv
or NEUC=5 Sv ?
SEUC=7 Sv ?
sSEC=-7 Sv
SECC= 6Sv
cSEC=-13 Sv
SEUC=17 Sv
NEUC=15 Sv
0–100m
100–200m
200–300m
300–500m
500–800m
Total
20N 15 10 5N 0 5S 10 15 20 25 30S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30°N
20°N
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10°S
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40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NECC
NEUC
nSEC
cSEC
SEUC
cSEC
SECC
sSEC
20C
10C
Sea Height (cm)
160
140
120
100
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
NEC
NECC+NEUC
nSEC
cSEC
Transport (Sv)
20
10
0
-10
-20
-30
0–100m
100–200m
200–300m
300–500m
500–800m
Total
NECC=15 Sv
NEUC=5 Sv
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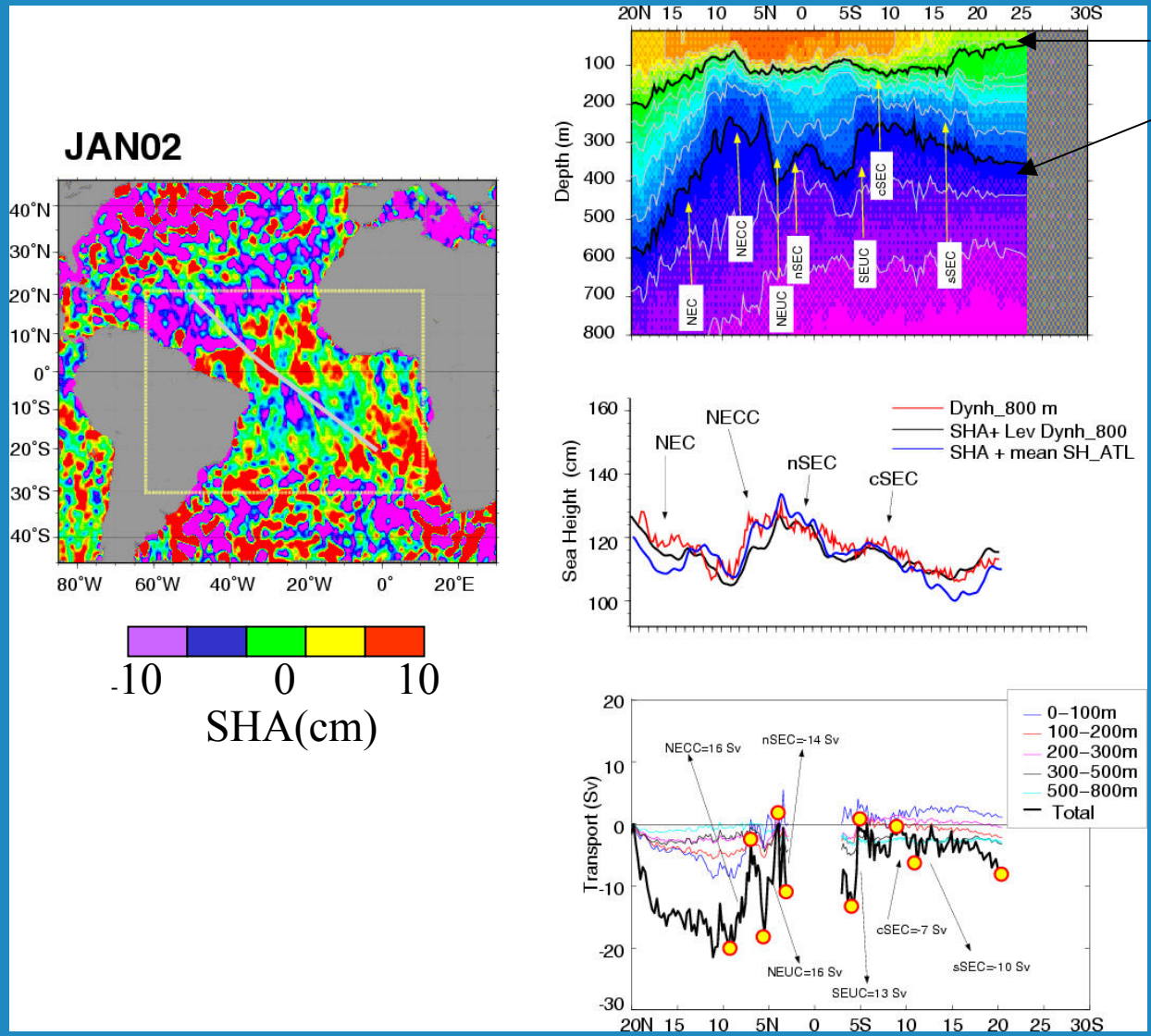
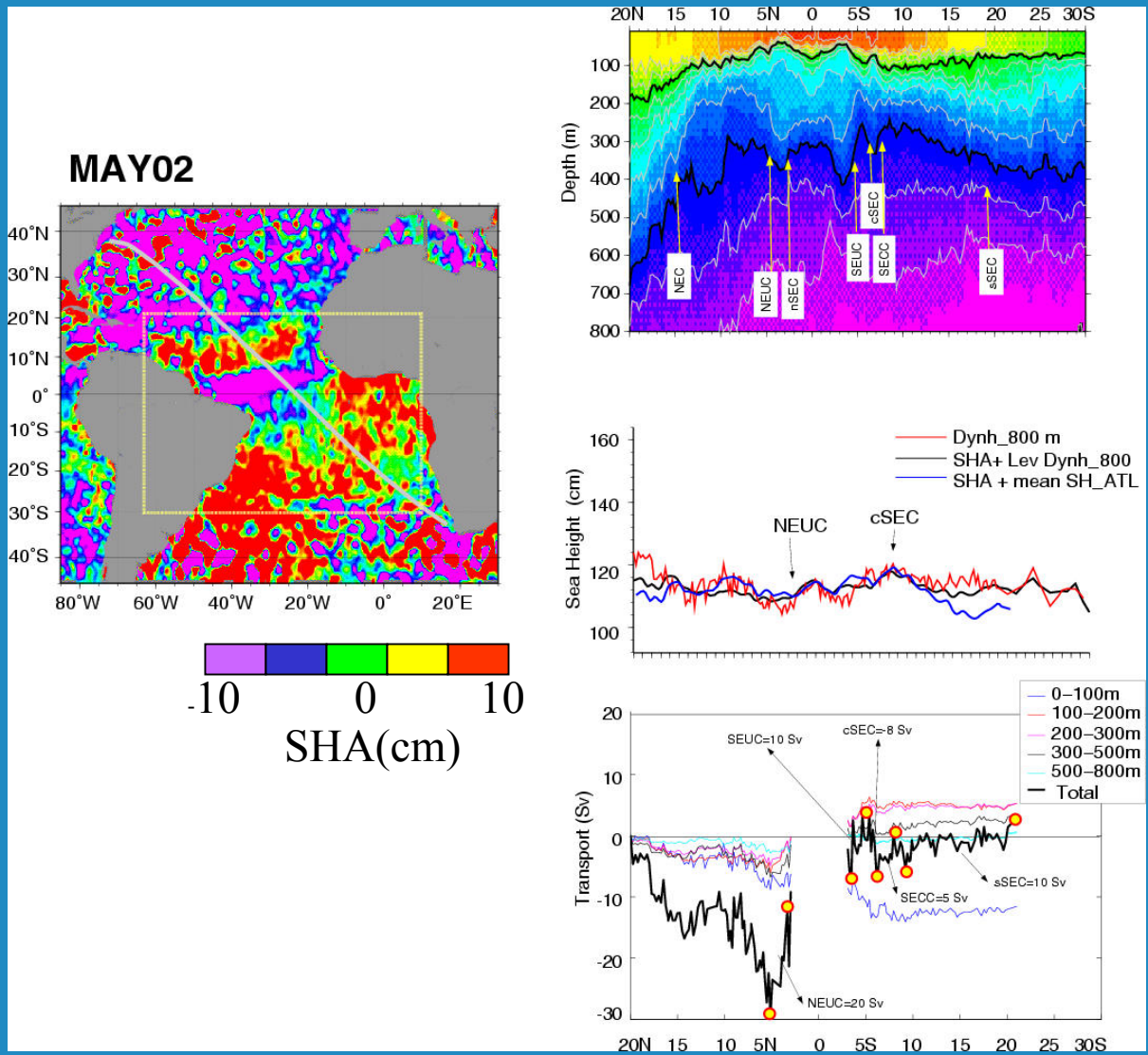
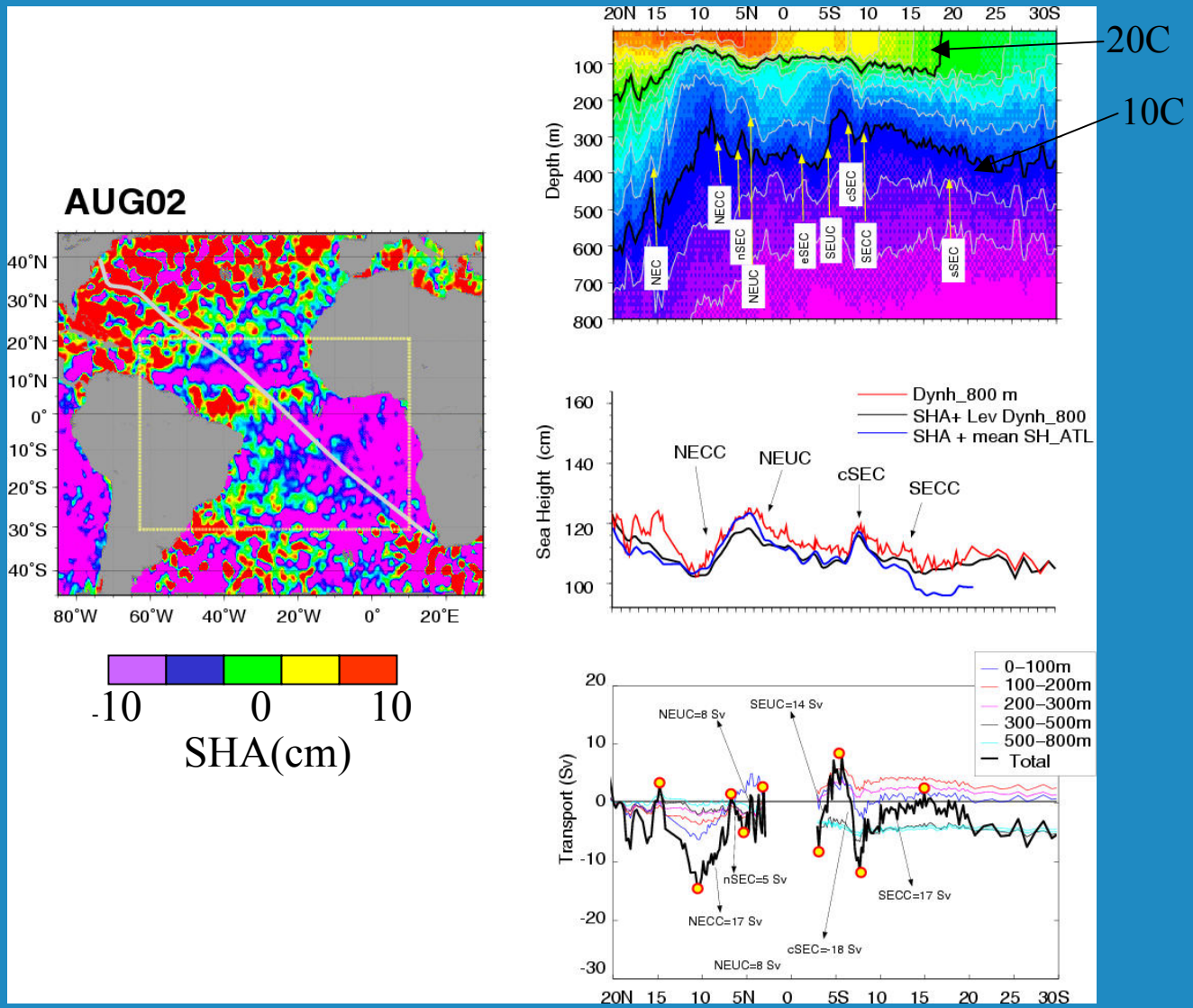
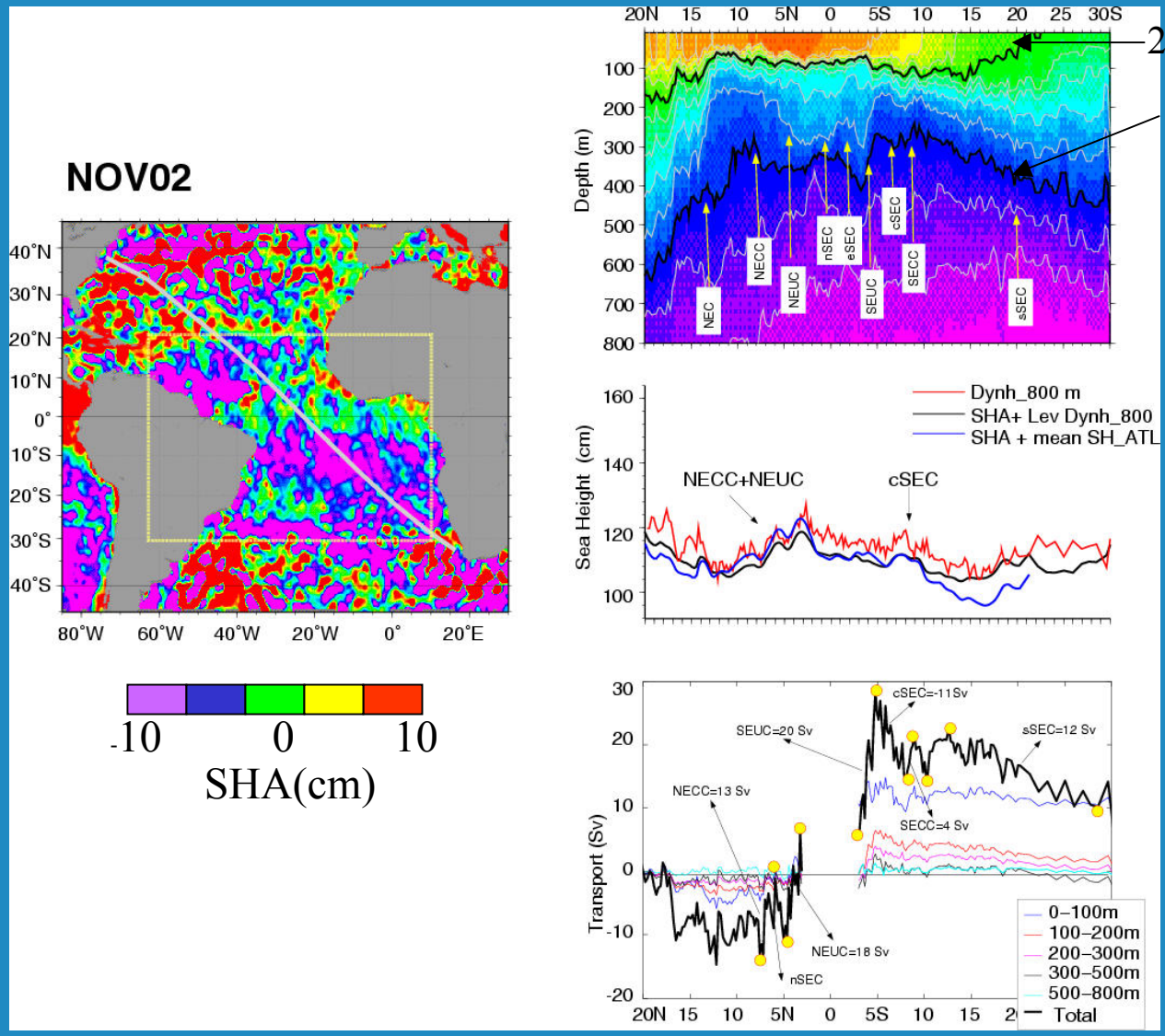
sSEC=11 Sv
SEUC=10 Sv
cSEC=-10 Sv
SECC=12 Sv
20N 15 10 5N 0 5S 10 15 20 25 30S


JAN02
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NECC
NEUC
nSEC
SEUC
cSEC
sSEC
20C
10C
Sea Height (cm)
160
140
120
100
NEC
NECC
nSEC
cSEC
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
Transport (Sv)
20
10
0
-10
-20
-30
NECC=16 Sv
nSEC=-14 Sv
cSEC=-7 Sv
sSEC=-10 Sv
NEUC=16 Sv
SEUC=13 Sv
0–100m
100–200m
200–300m
300–500m
500–800m
Total

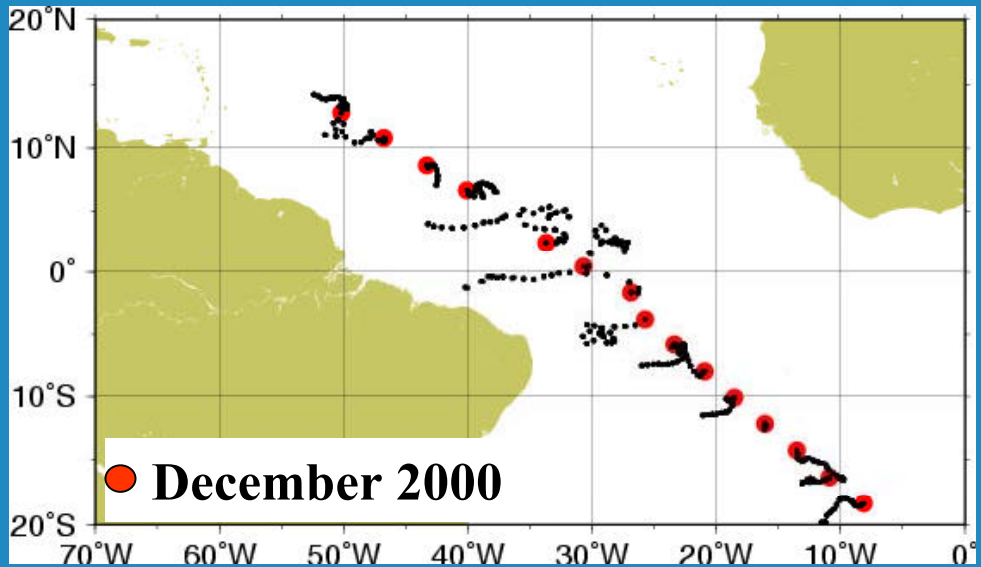

MAY02
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NEUC
nSEC
SEUC
SECC
cSEC
sSEC
20C
10C
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
Sea Height (cm)
160
140
120
100
NEUC
cSEC
0–100m
100–200m
200–300m
300–500m
500–800m
Total
Transport (Sv)
20
10
0
-10
-20
-30
SEUC=10 Sv
cSEC=8 Sv
sSEC=10 Sv
SECC=5 Sv
NEUC=20 Sv
20N 15 10 5N 0 5S 10 15 20 25 30S


AUG02
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NECC
nSEC
NEUC
eSEC
SEUC
SECC
cSEC
sSEC
20C
10C
Sea Height (cm)
160
140
120
100
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
NECC
NEUC
cSEC
SECC
Transport (Sv)
20
10
0
-10
-20
-30
0–100m
100–200m
200–300m
300–500m
500–800m
Total
NEUC=8 Sv
SEUC=14 Sv
nSEC=5 Sv
NECC=17 Sv
cSEC=-18 Sv
SECC=17 Sv
NEUC=8 Sv
20N 15 10 5N 0 5S 10 15 20 25 30S


NOV02
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
80°W
60°W
40°W
20°W
0°
20°E
-10
0
10
SHA(cm)
20N 15 10 5N 0 5S 10 15 20 25 30S
Depth (m)
100
200
300
400
500
600
700
800
NEC
NECC
NEUC
nSEC
eSEC
SEUC
cSEC
SECC
sSEC
20C
10C
Sea Height (cm)
160
140
120
100
Dynh_800 m
SHA+ Lev Dynh_800
SHA + mean SH_ATL
NECC+NEUC
cSEC
Transport (Sv)
30
20
10
0
-10
-20
cSEC=-11Sv
SEUC=20 Sv
sSEC=12 Sv
NECC=13 Sv
SECC=4 Sv
NEUC=18 Sv
nSEC
0–100m
100–200m
200–300m
300–500m
500–800m
Total

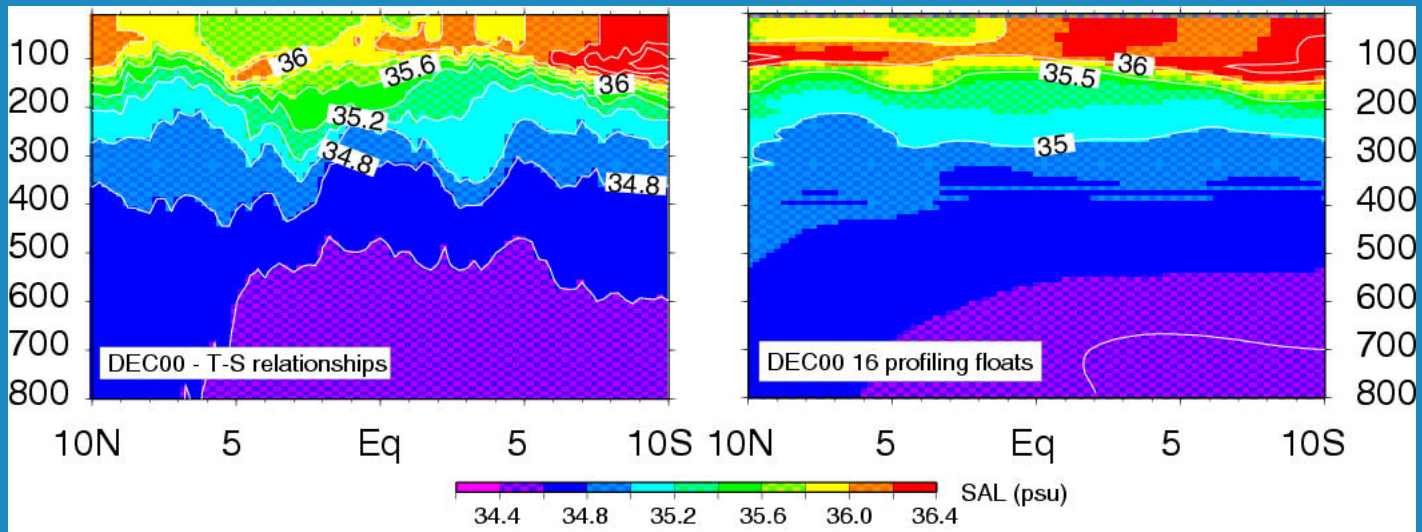
Profiling float deployment on AX08

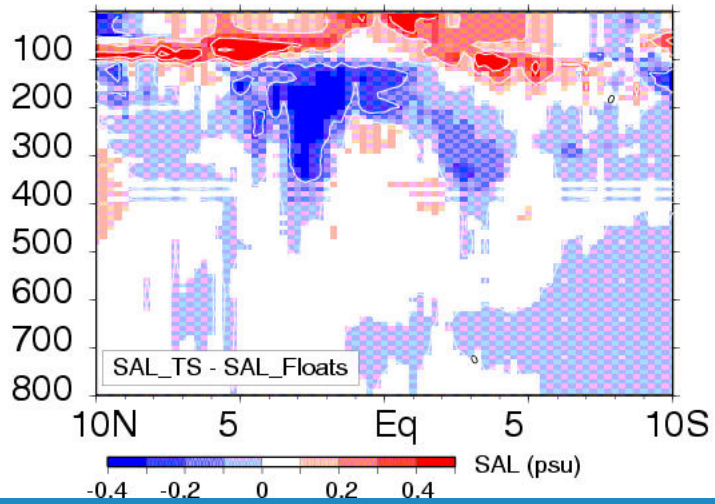
- 15 profiling floats deployed in Dec 2000
- 40+ profiling floats deployed to this date



S from T-S historical rel

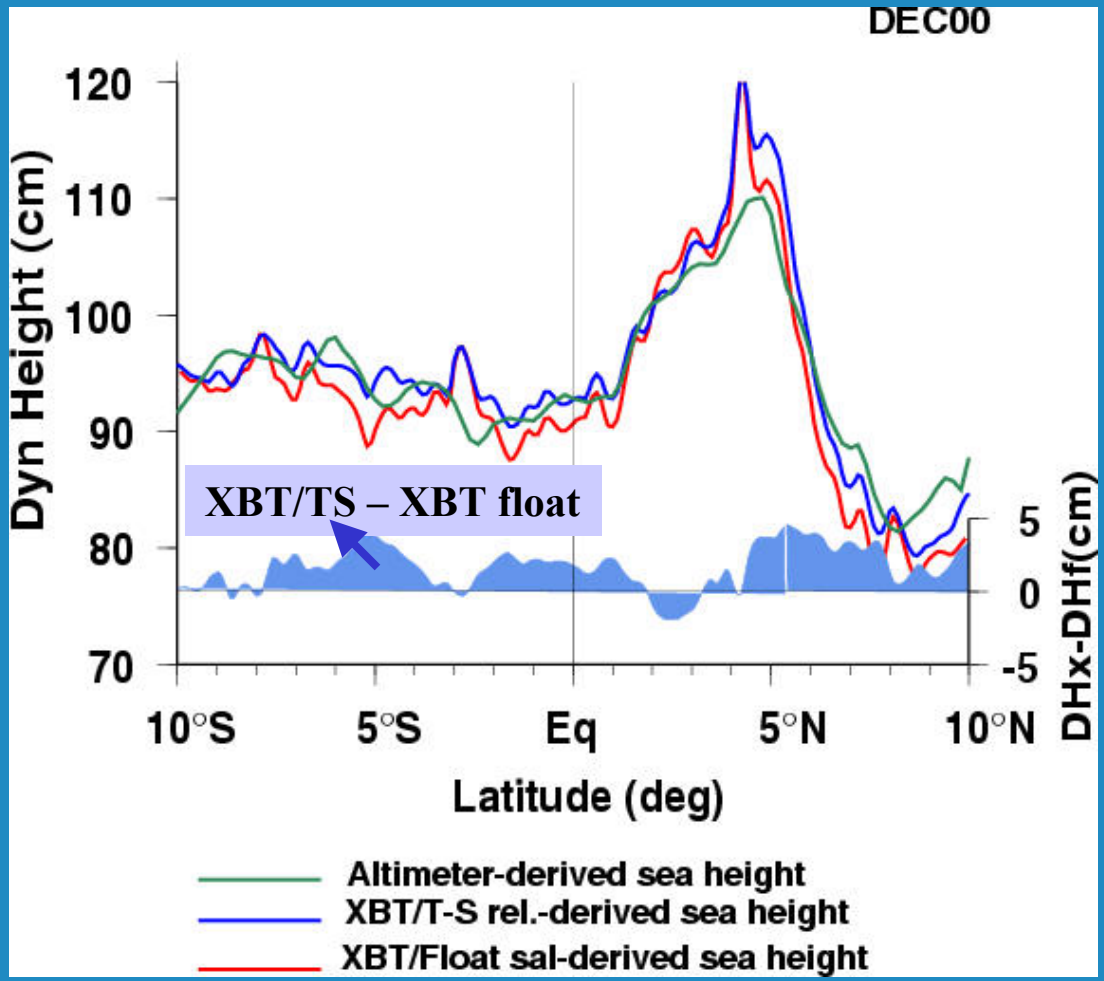
S from profiling floats





Difference
PF-Histor

Salinity uncertainties & Dyn Heights



Surface currents During the first three transects

Will soon be improved, expanded

Current	December 2000		September 2001		January 2002	
	location	Sv	location	Sv	location	Sv
NEC	19.7-9.7°N	-23	19-13.1°N	-15	19.8-11.1°N	-22
NECC	7.2-4.9°N	25	9.7-5.6°N	22	9.3-7°N	16
nSEC	4.9-3.7°N	-20	5.6-3.2°N	-20	7-5.5°N	-14
NEUC	3.7-3.0°N	14	-	-	5.5-3.9°N	18
nSEC	3.0-1.7°N	-37	-	-	3.9-2.2°N	-30
eSEC	1.5-3.6°S	-36	1.7-4.3°S	-5	1.8-4.2°S	-13
SEUC	3.6-5.2°S	17	4.3-5.4°S	11	4.2-4.7°S	14
cSEC	5.2-6.8°S	-13	5.4-6.9°S	-11	4.7-8.0°S	-6
SECC	10-12.9°S	6	6.7-9.5°S	11	8.0-9.3°S	7
sSEC	12.9-19.9°S	-7	9.5-15.3°S	-10	9.3-20°S	-8

IMPROVEMENTS

- *Intermediate to high density XBT deployment to Cape Town, underway*
- *Include TSG, too problematic, expensive*
- *Include XCTD, expensive, not included in current budget*
- *Include deeper XBTs, to 2000 m deep, expensive, redesign of autolaunchers, not included in current budget*
- *More profiling float data, depending on funding and interest*

Current and Immediate future work

* Obtain mean locations, transports, from monthly mean temperature sections.

* Relationship between surface currents and sea height signature.

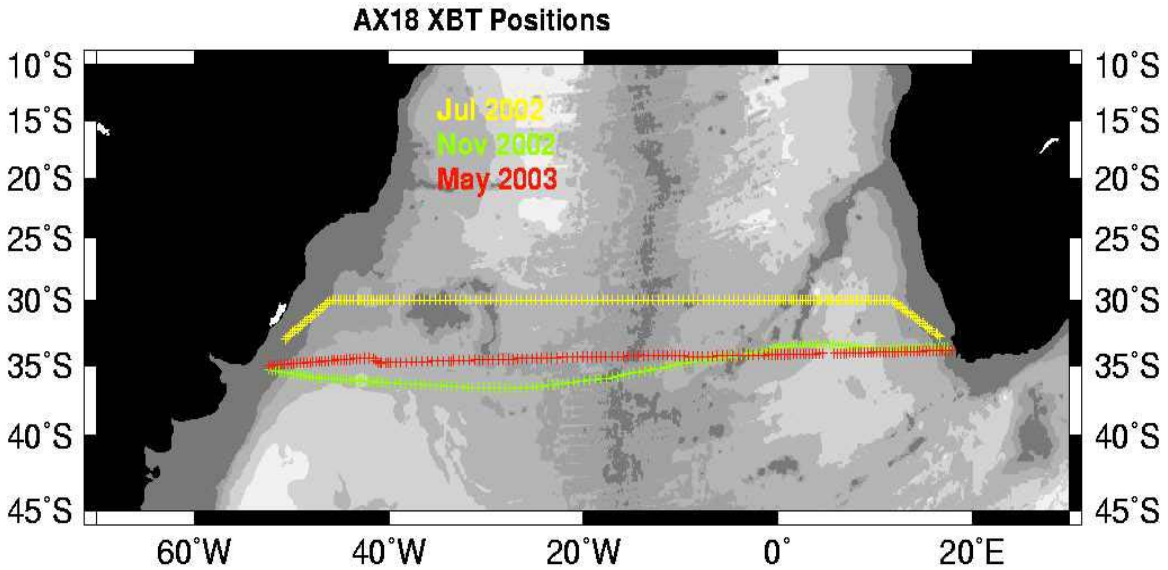
* Investigate and (maybe) quantify the effect of waves in the synoptic temperature sections, the dynamic height and transport estimates.

* Compare our results with estimates from drifters and CM in PIRATA mooring (33°W).

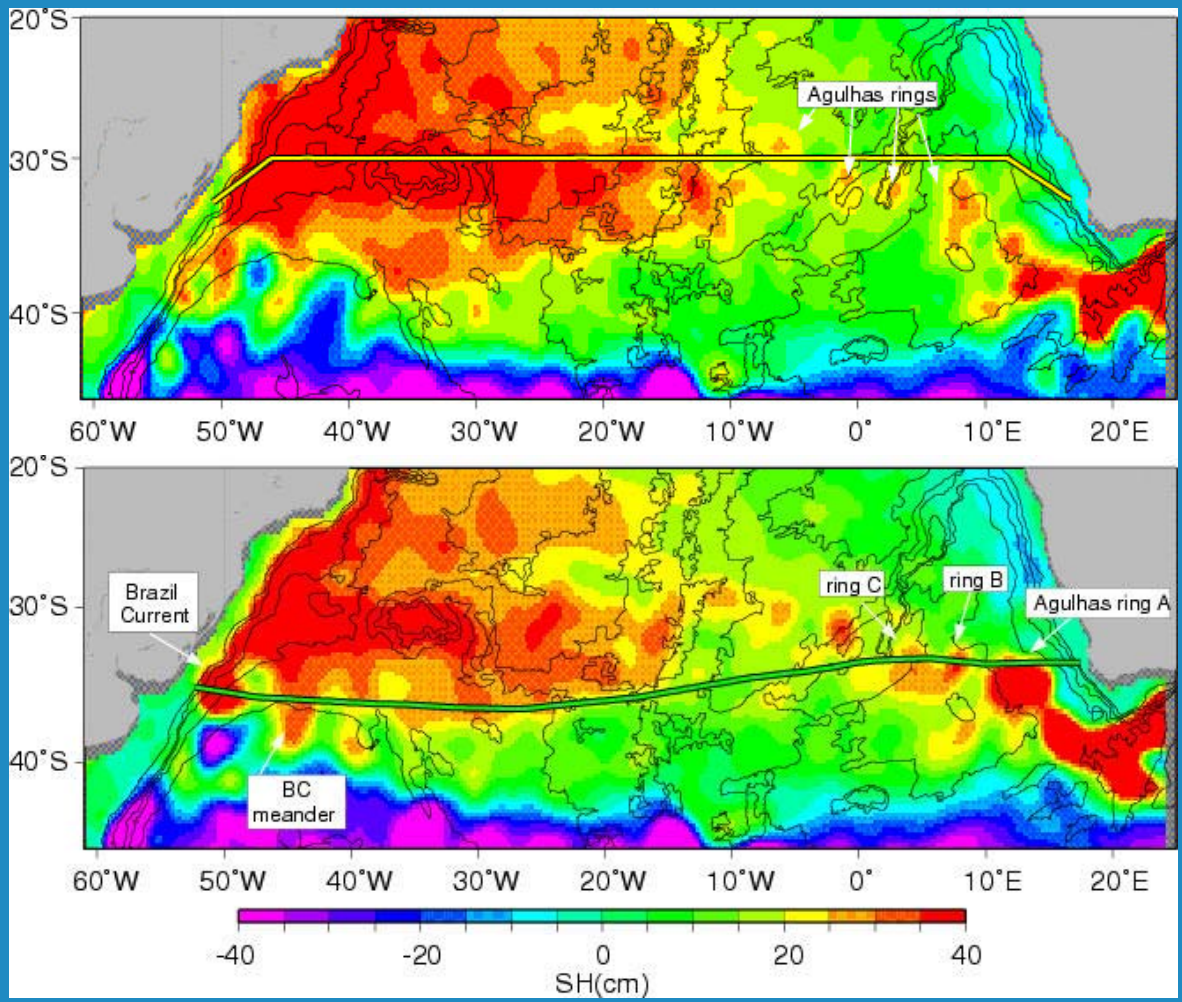
* Compare our results with estimates obtained from numerical models.

* Use these results to improve the methodology used to monitor surface currents in NRT from altimetry in CoastWatch.

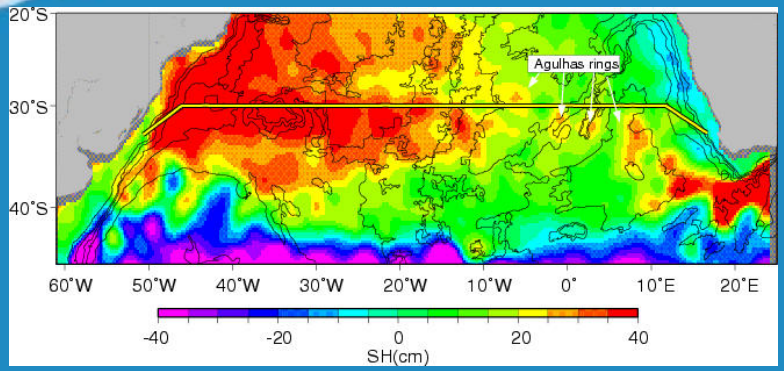
The first three transects of AX18

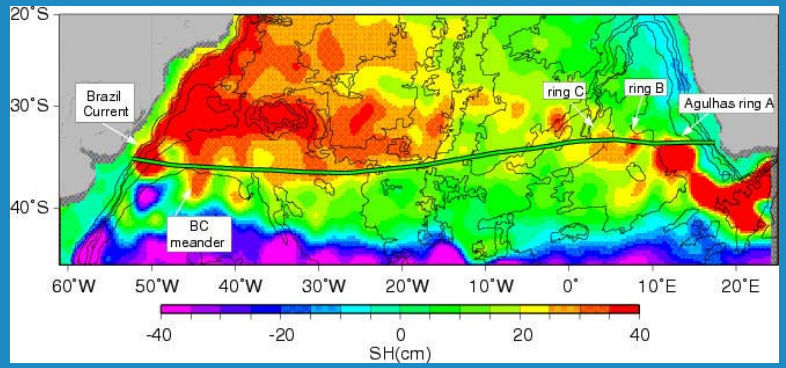


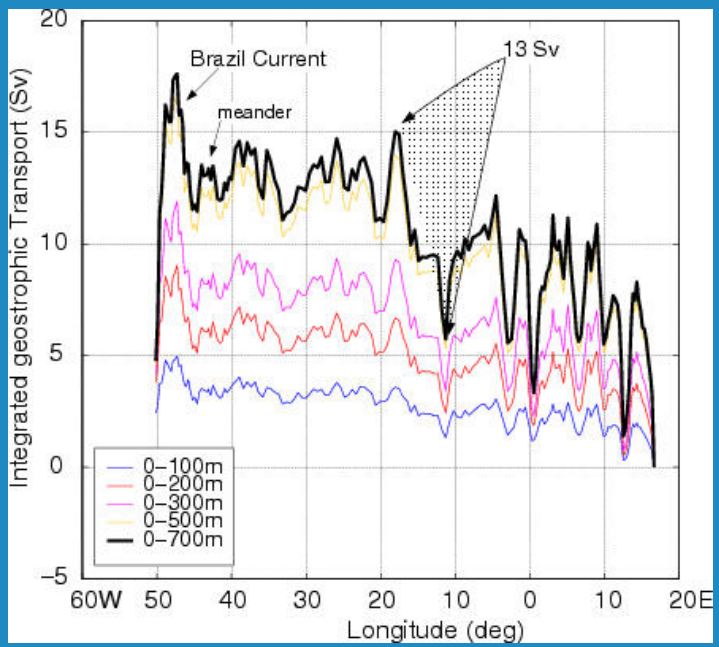
The transects and the upper ocean dynamics

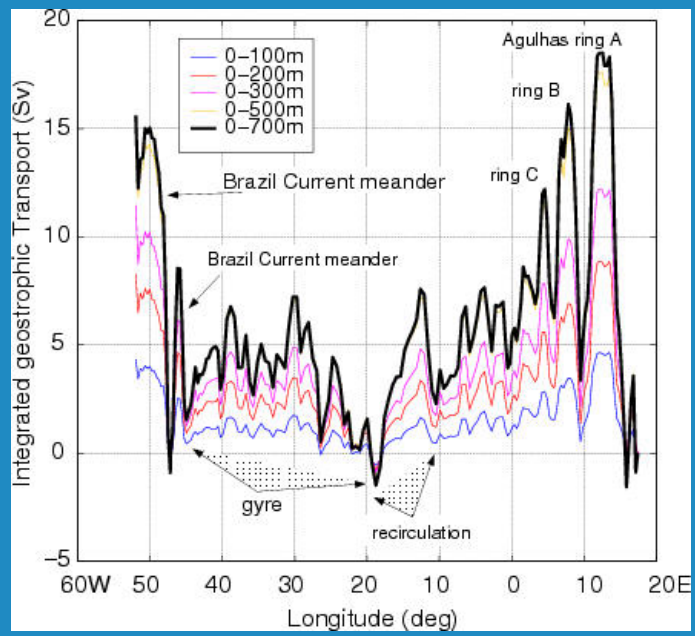


Cumulative geostrophic transports





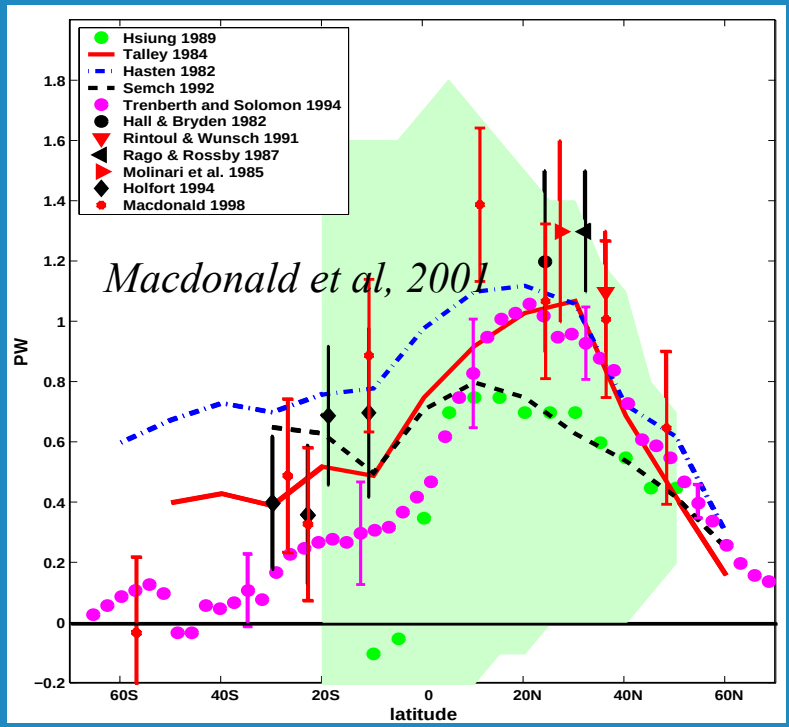




AX18 and the Meridional heat flux in the Atlantic Ocean

In the South Atlantic the meridional heat flux is uncertain, estimates vary between -0.4 and +0.9 PW.

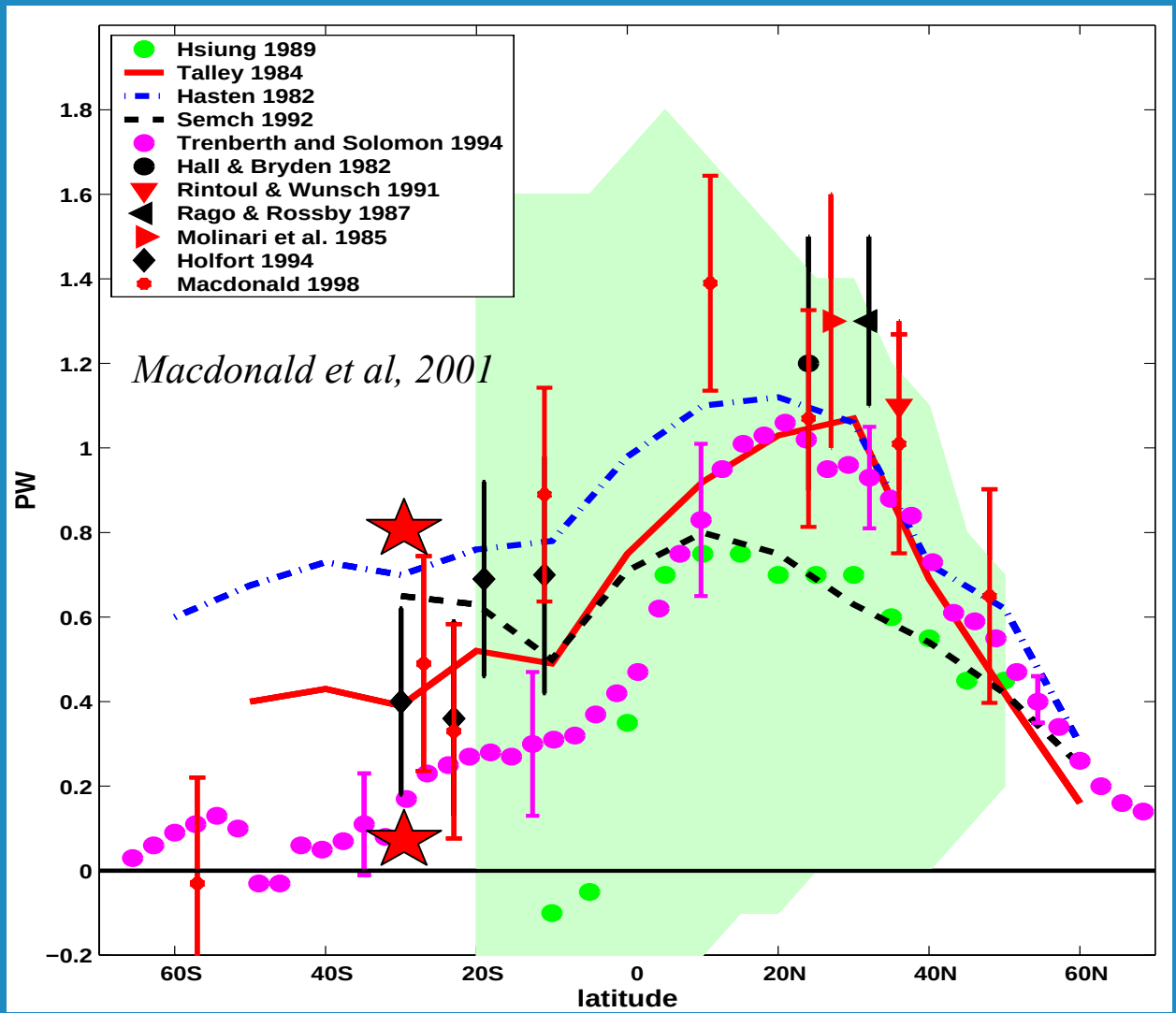
To better understand the global ocean thermohaline circulation and its impact on climate it is necessary to reduce the heat flux uncertainty in the South Atlantic



Estimates of South Atlantic meridional heat flux near 30°S

Lat °S	*Heat Flux PW*	*Method /*	*Source*
32	0.66-0.88	Inverse	*Fu (1981)*
30	0.69	Sea-air fluxes	*Hastenrath (1982)*
32	0.16-0.68	Direct	*Bennett (1978)*
32.5	0.63	Numerical model	*Donners*
32	0.4	Direct	*Bryan (1962)*
30	0.39	Sea-air fluxes	*Bunker (1980)*
30	0.38	Sea-air fluxes	*Hsiung (1985)*
30	0.3	Inverse	*Macdonald & Wunsch (1996)* *Ganachaud & Wunsch (2000)*
30	0.29	Numerical model	*Marchesiello et al. (1998)*
30	0.26	Numerical model	*Matano (pers. comm., 2003)*
32	0.24	Inverse	*Rintoul (1991)*
30	0.22	Direct	*McDonogh and King (2003)*
30	0.19	Numerical model	*Matano & Philander (1993)*
30	- 0.23	Inverse	*de las Heras & Schlitzer (1999)*

The first two estimate of meridional heat flux



Data distribution

www.aoml.noaa.gov/phod/hdenxbt

High Density XBT Lines - Netscape 6

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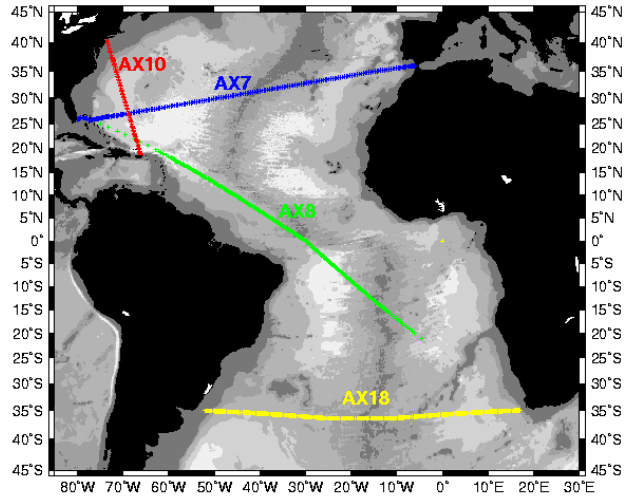
Atlantic Oceanographic & Meteorological Laboratory

National Oceanic & Atmospheric Administration

High Density XBT Lines

Personnel | Objectives | Sponsor | Rationale | Implementation | Results | References | Comments



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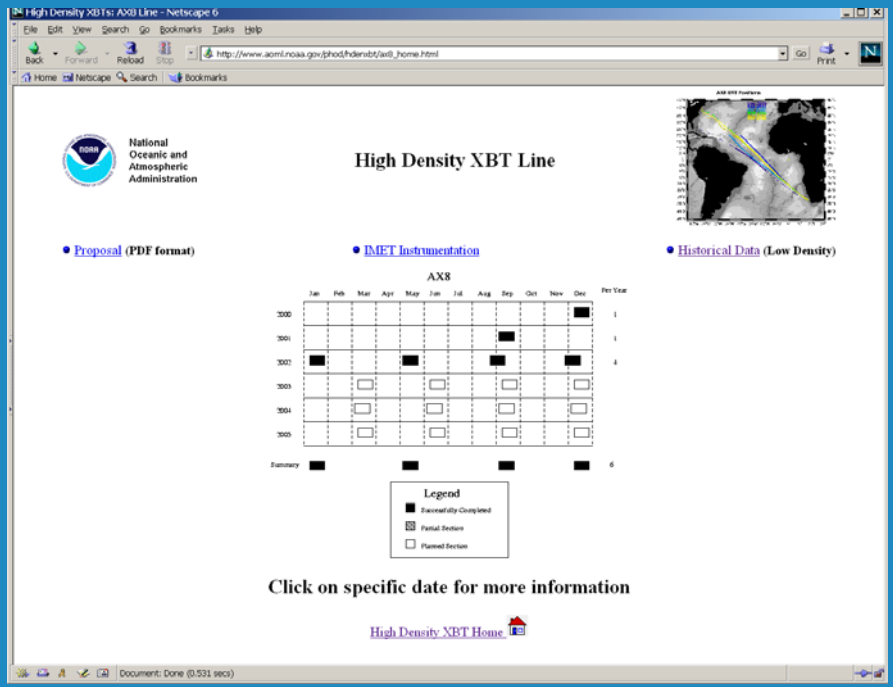
and then Submit

Principal Investigators: Data Processing:

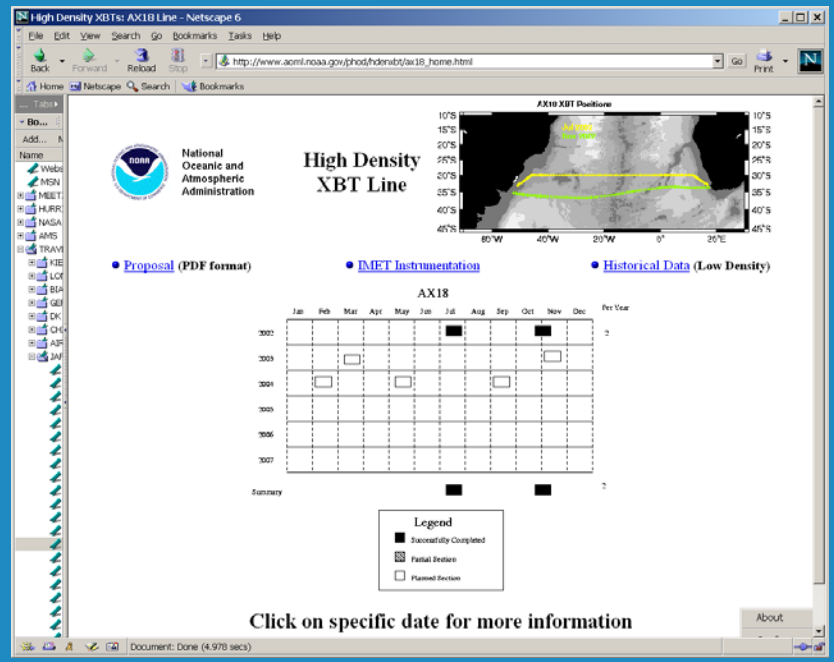
Document: Done (0.831 secs)

Data distribution

AX08



AX18



Current and Immediate future work

- Validate altimeter estimates of the transport of the Brazil and Agulhas currents.
- Validate altimeter estimates of the motion of the Brazil Current front.
- Continue with the estimates of meridional heat transport across 35°S.